

TO ALL TO WHOM THESE: PRESENTS SHALL COME: South Ankota Agricultural Experiment Station

Decres, there has been presented to the

Secretary of Agriculture

AN APPLICATION REQUESTING A CERTIFICATE OF PROTECTION FOR AN ALLEGED DISTINCT VARIETY OF SEXUALLY REPRODUCED, OR TUBER PROPAGATED PLANT, THE NAME AND DESCRIPTION OF WHICH ARE CONTAINED IN THE APPLICATION AND EXHIBITS, A COPY OF WHICH IS HEREUNTO ANNEXED AND MADE A PART HEREOF, AND THE VARIOUS REQUIREMENTS OF LAW IN SUCH CASES MADE AND PROVIDED HAVE BEEN COMPLIED WITH, AND THE TITLE THERETO IS, FROM THE RECORDS OF THE PLANT VARIETY PROTECTION OFFICE, IN THE APPLICANT(S) INDICATED IN THE SAID COPY, AND WHEREAS, UPON DUE EXAMINATION MADE, THE SAID APPLICANT(S) IS (ARE) ADJUDGED TO BE ENTITLED TO A CERTIFICATE OF PLANT VARIETY PROTECTION UNDER THE LAW.

NOW, THEREFORE, THIS CERTIFICATE OF PLANT VARIETY PROTECTION IS TO GRANT UNTO THE SAID APPLICANT(S) AND THE SUCCESSORS, HEIRS OR ASSIGNS OF THE SAID APPLICANT(S) FOR THE TERM OF TWENTY YEARS FROM THE DATE OF THIS GRANT, SUBJECT TO THE PAYMENT OF THE REQUIRED FEES AND PERIODIC REPLENISHMENT OF VIABLE BASIC SEED OF THE VARIETY IN A PUBLIC REPOSITORY AS PROVIDED BY LAW, THE RIGHT TO EXCLUDE OTHERS FROM SELLING THE VARIETY, OR OFFERING IT FOR SAIE, OR REPRODUCING IT, OR IMPORTING IT, OR EXPORTING IT, OR CONDITIONING IT FOR PROPAGATION, OR STOCKING IT FOR ANY OF THE ABOVE PURPOSE, OR CONDITIONING IT BY PROPAGATION, OR STOCKING IT FOR ANY OF THE ABOVE PURPOSE, OR USING IT IN PRODUCING A HYBRID OR WRENT VARIETY THEREFROM, TO THE EXTENT PROVIDED BY THE PLANT VARIETY PROTECTION ACT. IN THE STATES SEED OF THIS VARIETY (I) SHALL BE SOLD BY VARIETY NAME ONLY AS A CLASS OF CERTIFIED STATES SEED OF THIS VARIETY (I) SHALL BE SOLD BY VARIETY NAME ONLY AS A CLASS OF CERTIFIED SHALL CONFORM TO THE NUMBER OF GENERATIONS SPECIFIED BY THE OWNER OF THE RIGHTS. (84 STAT. 1542).

WHEAT, COMMON

'Harding'

In Testimony Wherest, I have hereunto set my hand and caused the seal of the Flant Institute Isotextion Office to be affixed at the City of Washington, D.C. this nineteenth day of September, in the year two thousand and three.

Allest: 444 (1)

Thomas a Salt

Acting Commissioner Plant Variety Protection Office Agricultural Marketing Service

Secretary of Six

U.S. DEPARTMENT OF AGRICULTURE AGRICULTURAL MARKETING SERVICE SCIENCE AND TECHNOLOGY - PLANT VARIETY PROTECTION OFFICE

&T-470 (2-99) designed by the Plant Variety Protection Office with WordPerfect 6.0a. Replaces STD-470 (6-98) which is obsolete.

The following statements are made in accordance with the Privacy Act of 1974 (5 U.S.C. 552a) and the Paperwork Reduction Act (PRA) of 1995.

Application is required in order to determine if a plant variety protection certificate is to be issued (7 U.S.C. 2421). Information is held confidential until partition in the confidential unit in the confidentia

(See reverse for instructions and information collection burden statement)

(Instructions and information coll	ection burden statement on r	everse)). Information is held confident		
	ricultural Experi	nent Stati	on	2. TEMPORARY DESIGNA EXPERIMENTAL NAME SD92107	TION OR	3. VARIETY NAME Harding
4. ADDRESS (Street and No., or R.F.D. No South Dakota Sta	., City, State, and ZIP Code, and Cour Dite University	ntry)		5. TELEPHONE (Include an	ea code)	FOR OFFICIAL USE ONLY
Ag Hall 129				605-688-4149		PVPO NUMBER
Brookings, SD !	57007			6. FAX (include area code)		200100268
			•	605-688-6065		FILING DATE
IF THE OWNER NAMED IS NOT A "PER ORGANIZATION (corporation, partnershi)	SON", GIVE FORM OF c, association, etc.)	8. IF INCORPOR STATE OF IN	RATED, GIVE CORPORATION	9. DATE OF INCORPORAT	ION	Soptember 4,20
Agricultural Exp		l N/A		N/A		
Dr. Kevin Kephar SD Ag. Exp. Stat South Dakota Sta Brookings, SD 5	t, Director ion, Box 2207 ite University	Dr. Ami Plant S NPB 244		W. Wheat Breed artment D-C, SDSU		FILING AND EXAMINATION FEES: \$ 2705.00 R C C C C C C C C C C C C C C C C C
			·			\$ 432.00 DATE 9/16/2003
11. TELEPHONE (Include area code)	12. FAX (Include area code)	13. E-I	MAIL		14 CROPK	DATE 1/16/200 =
(605) 688-4453	(605) 688-4452	Ami	r_Ibrahim@s	sdstate.edu		Red Winter Wheat
verification that tissue culture w repository) g. [X] Filing and Examination Fee (\$2 States" (Mail to the Plant Variet)	History of the Variety tness n of Variety n of the Variety (Optional) sis of the Owner's Ownership untreated seeds or, for tuber propagat ill be depositied and maintained in an 1705), made payable to "Treasurer of to y Protection Office)	ed varieties, approved public he United	20. DOES THE OVARIETY BE LED STATE OF THE OVARIETY AS T	SEED? See Section 83(a) of (if "yes", enswer items 20 and 21 below) Where Specify That Seed of the Classes? Foundary Where Specify That The Clonumber of Generation of G	OF THIS CLASSES? ASSES BE S? ASSES BE S? Use the space	YES NO REGISTERED CERTIFIED CERTIFIED CERTIFIED CERTIFIED CERTIFIED Indicated on the reverse.)
22. HAS THE VARIETY (INCLUDING ANY HAE FROM THIS VARIETY BEEN SOLD, DISP OTHER COUNTRIES? AND YES Sept. 1, 200 IF YES, YOU MUST PROVIDE THE DATE FOR EACH COUNTRY AND THE CIRCUIT	OSED OF, TRANSFERRED, OR USE OF FIRST SALE, DISPOSITION, TR	D IN THE U. S. OR ANSFER. OR USE	PROPERTY RI	TY OR ANY COMPONENT OF IGHT (PLANT BREEDER'S RIC COUNTRY, DATE OF FILING C RUMBER. (Please use space in	EHT OR PATE! NO OR ISSUANCE!	AND ASSIGNED
24. The owners declare that a viable sample of for a tuber propagated variety a tissue cult. The undersigned owner(s) is(are) the owner and is entitled to protection under the providences of the company of the providences.	er of this sexually reproduced or tuber sions of Section 42 of the Plant Variet	propagated plant va y Protection Act.	nor the duration of the riety, and believe(s) tha	сепясате.		
SIGNATURE OF OWNER	al of		SIGNATURE OF O	WNER		
NAME (Please print or type) Dr. Kevin Kephart			NAME (Please prin	t or type)		
CAPACITY OR TITLE Director, SD Ag. E.	DATE XD. Station August	29, 2001	CAPACITY OR TIT	LE	1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1	DATE

EXHIBIT A Harding (SD92107) Origin and Breeding History of the Variety

Harding was selected as an $F_{5:6}$ line from the cross 'Brule'//'Bennett'/'Chisholm'/3/'Arapahoe' (parentage is 50% Arapahoe) made in 1986. The cross was advanced without deliberate selection to the F5 generation with a bulk breeding procedure. The F₁ plants were planted at the greenhouse in Brookings, South Dakota in 1987. The F2-bulk population was grown in the field at Brookings and Highmore, South Dakota and harvested as bulk in July 1988. Selections among the F2-bulks were made based on grain yield, test weight, pedigree, disease resistance, maturity, plant height, and resistance to lodging. However, no selection within these bulks was done at this stage. The F3-bulk was advanced to the F4 and F5 generations in the same way with selection (grain yield, test weight, pedigree, disease resistance, maturity, plant height, and resistance to lodging) practiced among but not within populations. The F5-bulk population was grown in the field at Brookings and Dakota Lakes Research Farm near Pierre, South Dakota, and about 100 heads were picked from the most promising populations, including Brule//Bennett/Chisholm/3/Arapahoe, using the same traits with which the F_2 - F_4 bulks were advanced. Selection of F₅ plants within each F₅-bulk population was done at random. The head rows were planted in Dakota Lakes Research Farm near Pierre, South Dakota in 1991 and selection among these rows was done based on maturity, pedigree, and resistance to lodging and diseases. Harding was identified as experimental line SD92107 in 1992. Harding was then grown in the un-replicated early yield trial in Brookings, Selby, and Winner, South Dakota. Selection at this generation was based on yield, test weight, disease resistance, and quality characteristics. The most promising lines were advanced to the preliminary yield trial (5 locations) and then the advanced yield trial the following year (6 locations). Harding has been tested in the South Dakota Crop Performance Testing (CPT) Variety Trial since 1996 and the Northern Regional Performance Nursery (NRPN) from 1996 to 1998.

Composite milling and bread-baking data of Harding was provided by the USDA-ARS Hard Winter Wheat Quality Laboratory, Manhattan, KS from the South Dakota Advanced Yield Trial (1995 to 1998). Breeder seed, produced in 1997-1998, originated from a purification program in 1997-1998 (F₁₁ generation) to remove off-types by rouging. Foundation seed was produced in 1998-1999.

Harding has been uniform for all morphological characters (such as maturity and plant height) during the last four generations of selfing and increase. Variants are limited to slightly taller and later maturing plants that occur at a frequency of less than 1 in 1,000 plants. The variants in Harding as well as the typical plants in Harding are commercially acceptable. Up to 0.5% variant plants may be encountered in subsequent generations.

EXHIBIT B Harding (SD92107) Statement of Distinctness

Harding is most similar to the hard red winter wheat cultivar 'Crimson', but differs in the following characteristics:

- 1) Grain Yield: Harding has 0.1 LB/ACRE less grain yield than Crimson, when recorded directly from the combine (Table 1).
- 2) Test Weight: Harding has 2.4 LB/Bu less test weight than Crimson, when recorded directly from the combine (Table 1).
- 3) Heading Date: Harding heading is later by one day than Crimson (Table 1).
- 4) Plant Height: Harding is 0.7 inch taller than Crimson (Table 1).
- 5) Acid Polyacrylamide Gel Electrophoresis (PAGE): Acid Polyacrylamide Gel Electrophoresis shows that Harding and Crimson have distinctly different seed storage protein banding patterns. (Photograph 1). The arrows on the photograph point to bands present in Harding but missing in Crimson and vice versa.
- 6) Urea Polyacrylamide Gel Electrophoresis: Urea Polyacrylamide Gel Electrophoresis also shows that Harding and Crimson have distinctly different seed storage protein banding patterns (Photograph 2). The arrows on the photograph point to bands present in Harding but missing in Crimson and vice versa

Davis, B. 1964. Disc electrophoresis. II. Method and application to human serum protein. Ann. New York Acad. Sci. 121:404-427.

Table 1. South Dakota State University, Winter Wheat Breeding Trials Combined Over Locations and Years.

	(irain Yie	ld (bu/a)		T	est Weig	ht (lb/bu)		Headin	g (days))	Pla	ant Heigh	nt (inche	s)
	97	98	99	97-99	97	98	99	97-99	97	98	99	97-99	97	98	99	97-99
	(5)	(14)	(14)	(33)	(5)	(12)	(14)	(31)	(3)	(7)	(4)	(14)	(4)	(13)	(8)	(25)
CRIMSON	55.6	54.7	55.9	55.4	60.7	62.3	62.0	61.7	166	151	153	154	35.6	36.4	39.9	37.4
HARDING	64.7	52.2	55.0	55.3	59.6	58.4	60.0	59.3	166	152	153	155	36.8	37.4	39.9	38.1
ROSE	51.6	53.3	55.2	53.9	60.5	61.2	61.4	61.0	166	151	154	155	35.0	37.2	40.7	38.0
SIOUXLAND	55.2	55.7	61.8	58.2	58.7	60.7	59.3	59.6	164	149	151	153	37.2	37.8	42.1	39.1
CV %	13.9	13.7	14.2	14.6	1.8	1.9	2.1	1.9	1.1	0.8	0.8	0.8	5.6	5.3	6.5	4.0
LSD (10%)	4.1	2.3	2.4	1.6	0.6	0.5	0.6	0.3	1.2	0.5	0.7	0.4	1.2	0.6	1.1	0.4

N.B.: Figures in parentheses indicate the number of locations that data was collected from.



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PROCEDURE FOR POLYACRYLAMIDE GEL ELECTROPHORESIS

Written by J. Schneider and T. Machacek 1988 Revised 1989 by J. Johnson Revised 1991 by L. Fleege

This paper is written with the intent of passing on some practical information to laboratories which are interested in using polyacrylamide gel electrophoresis (PAGE) for the analysis of varietal purity of seed lots. Perhaps the practical experience we have gained from organizing and implementing our system will be of some assistance.

The lists which have been compiled are quite comprehensive of the needs for setting up a laboratory for PAGE. Personal preference may dictate changes in the glass and hardware, however the items listed seem to work the best for us. The equipment listed is essential for producing clear and reproducible results.

The chemical sources listed are those recommended to us (Lookhart et al., 1981) as the ones that produce the best results. Aluminum Lactate quality is important; it should be pure white (powdered sugar color). Impure Aluminum Lactate will result in blurred electrophorograms.

Reference samples of foundation seed (one pound) of each variety to be tested were collected and stored in plastic containers.

Thirty gram samples are collected in Udy bottles following purity testing. 100 seeds counted from each sample are ground in a small coffee grinder (Miracle Mill) and sifted through a 1.016 sieve. Use caution to avoid contamination between samples. Cleaning the grinder and sieve with forced air between samples is recommended.

PROTEIN EXTRACTION

Using a fine point marking pen, mark a 1.5 ml centrifuge tube for each sample. Wheat into each tube, add 750 μ l of Ethylene glycol and 0.25 g of flour. Extractions mix easier if the ethylene glycol is put in the tube first. Vortex the samples and wait an hour before centrifuging. Oat; into each tube, add 700 μ l of ethylene glycol and 0.30 g of flour. Vortex the samples and wait one hour before centrifuging. Single Seed; Crush each seed between weighing paper with a pliers. Place each into centrifuge tubes with 100 μ l of ethylene glycol and allow to set 1 hour. Load the centrifuge evenly. Run it on low speed (4500 x g recommended) for 10 minutes. [Optional: Add one drop of 10% methyl green dye (1 g methyl green brought to a volume of 10ml with H_1O) to each sample with a small sized auto pipette].

MIXING THE GEL SOLUTION

Each 1.5 mm thick gel will require 50 ml of gel solution. Use a 125 ml vacuum flask with stopper when mixing 100 ml of gel solution. Into the flask add each of the following. Note: when working with the gel solution wear gloves and a mask as acrylamide is a neurotoxin until it has solidified.

For two gels: Aluminum Lactate (0.25g); Ascorbic Acid (0.024g); FeSO₄-7H₂O (200 μ of 10mg/10ml mixed fresh);

Wheat:

Bis-Acrylamide (0.25g), Acrylamide (6.00g);

Oat:

Bis-Acrylamide (0.4g), Acrylamide (7.50g). Add distilled water to obtain a

volume of 100ml.

Add a stir bar, stopper the flask, and place on the stirrer at slow speed, connect the vacuum and allow it to stir for 20 minutes. (The vacuum step is optional.) After this time is up, allow the solution to continue stirring while the pH is checked and adjusted. Lower the pH to 3.1 by titrating with Lactic Acid. If the pH is over adjusted, Trizma base (5M) can be used to increase the pH without adverse effects. Divide the solution into 2 portions in 100ml flasks containing stir bars.

Prepare the gel plates making sure that they are tightly sealed to the rubber gaskets.

(This is very important but easy to forget).

Place one of the flasks containing gel solution on the stir plate at very slow speed. Note: excessive agitation mixes in oxygen which ties up the catalyst and prevents complete polymerization. Add 25 μ l of $\rm H_2O_2$ and allow to stir for 45 seconds. Carefully pour the solution between the plates until it is 1/4" from the top. Insert the gel comb making sure there are no bubbles trapped on the well ends. Repeat the procedure for the other gel and allow both to polymerize for 15 minutes.

TANK BUFFER

While waiting for the gel to polymerize, mix the tank buffer. Place 5.625 g of Aluminum Lactate in a 4000 ml flask. Fill the flask to approximately 4500 ml (middle of the neck on a 4000 ml flask) with distilled H₂O and stir. While the buffer stirs, check the pH. Titrate to 3.1 using Lactic Acid.

SAMPLE PLACEMENT

By this time the gel should be polymerized. Carefully remove the gel comb. Carcless removal can cause suction, pulling the gel walls together and possibly breaking them. Pipette out any excess fluid in the slots using a long needle syringe. If the walls of the gel are crooked, they can be straightened at this time with the needle. Fill the slots about 2/3 full with buffer solution. Then, using a digital pipette, place $7.5 \mu l$ of the sample extract $(12\mu l$ for single seeds) into the slots. The extract should sink to the bottom. Using a pasteur pipette finish filling the slots with buffer.

RUNNING THE GEL

Attach the upper buffer chamber to the gel plates making sure of a tight seal. Fill the upper buffer chamber with buffer one inch from the top. Pour the remaining buffer into the lower buffer chamber along with the stir bar. Set the tank on a stir plate and set the stir plate to a last speed. This aids in maintaining an even temperature during the run.

Put the apparatus together. Make sure that the cathode is connected to the lower buffer and the anode to the top. Start the water bath and set it for 15C. Set the power source to constant current, switch it on and turn power up to 500 volts. The amperage, when running two gels, should initially read approximately 160 to 170 ma. Allow it to run 2

hours for wheat and oats.

MIXING THE STAINING SOLUTION

Take safety precautions to prevent eye and skin contact when working with the acid solutions. To make 600 ml of stain, mix in a 1000 ml flask the following: 100 grams TCA and 600 ml distilled H₂O. Add 20 ml of 1% Comassic brilliant blue (CBB) solution (1g CBB per 100ml ETOH).

REMOVING THE GELS

After 2 hours turn the power off and remove the gel plates. Remove the spacers and pry the plates apart (It is recommended using one of the spacers for this task. Take care as to not damage the spacer in the process). To keep track of the slot order, cut off the lower left hand corner. Then remove the slot fringes. The gel can then be loosened by running a spatula between it and the glass plate while squirting water in the gap created by the spatula. The gel should slide off into the staining pan (be sure to label the pan).

STAINING

Remove any excess water and add 300ml of stain. Place the trays on a shaker at gentle speed and allow them to stain for at least 4-6 hours. Over staining will not harm the gels or their results. Sometimes overnight staining is more convenient.

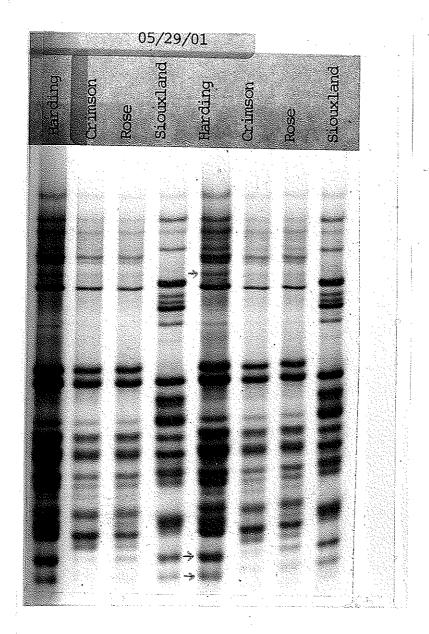
DESTAINING

Remove the stain (A handy way to remove liquids is with the vacuum pump. Put a catch bottle in the line and use a pasteur pipette in the hose end.) Add 300ml of H₂O to the tray. Put the trays on the shaker and allow to destain for 2-6 hours or whatever is necessary for acceptable results. A useful tool for moving the gel is a piece of plastic 11" x 6" from a report cover. Use the plastic sheet to place the gels into one quart zip-lock freezer bags.

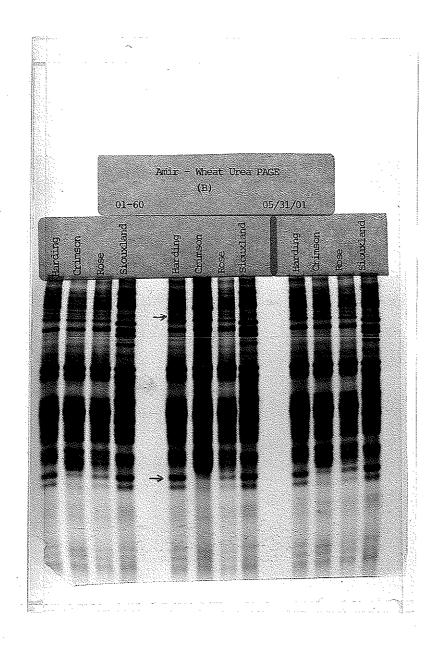
CLEANING THE GEL PLATES

For easy and flawless removal of the gets, a thorough cleaning of the plates is essential. Wash them well with soapy water. Then wipe them down with ammonia glass cleaner or ethanol. Put the glass together with the spacers and clamps making sure that everything is flush on the bottom. Put them in the stand, insert the combs, and cover with plastic wrap. They are now ready for the next use.

Photograph 1. Acid Polyacrylamide Gel Electrophoresis (PAGE) of hard red winter wheat cultivars Harding, Crimson, Rose, and Siouxland. The Acid PAGE was conducted by Dr. Brent Turnipseed, Seed Testing Lab, Plant Science Department, South Dakota State University.



Photograph 2. Urea Polyacrylamide Gel Electrophoresis (PAGE) of hard red winter wheat cultivars Harding, Crimson, Rose, and Siouxland. The Urea PAGE was conducted by Ms. Mary Thompson, Seed Testing Lab, Plant Science Department, South Dakota State University.



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U.S. DEPARTMENT OF AGRICULTURE AGRICULTURAL MARKETING SERVICE SCIENCE AND TECHNOLOGY PLANT VARIETY PROTECTION OFFICE BELTSVILLE, MD 20705

(Whea

OBJECTIVE DESCRIPTION OF VARIETY

		WHEAT (Triti	cum spp.)		
NAME OF APPLICANT(S)	D. L		<u> </u>	FOR OFFICIAL USE ONLY	
	Dakota Agricultural	Experiment Stat	ion	PVPO NUMBER	
	RD No., City, State, and Zip Code)				
Ag Ha	Dakota State Univer 11 129 ings, SD 57007	sity		VARIETY NAME Hard	ing
				TEMPORARY OR EXPERIMEN SD92	107
a minimum of 100 plant may be used to determin	INSTRUCTIONS CAREFULLY: box (e.g. 0 9 9 or 0 9) who s. Comparative data should be dete to plant colors; designate system use tons for your variety; lack of response	rmined from varieties entered i	in the same trial. Royal	Data for supplied to a live of	
i. KIND:			· - · · · · · · · · · · · · · · · · · ·		
1	1=Common	2=Durum	3=Club	4=Other	(SPECIFY):
2. VERNALIZAT	TION:	- <u> </u>	·		****
2	1=Spring	2=Winter	3=Other (S	PECIFY) :	· .
3. COLEOPTILE	ANTHOCYANIN:				
	1=Absent	2=Present			•
4. JUVENILE PL	ANT GROWTH:				· · · · · · · · · · · · · · · · · · ·
1	1=Prostrate	2=Semi-erect	3=Erect		
5. PLANT COLO	R (boot stage):				
2	1 = Yellow-Green	2 = Green	3 = Blue-Gre	een	·
6. FLAG LEAF (t	oot stage):				
1	1 = Erect	2 = Recurved	.2	1 = Not Twisted	2 = Twisted
7. EAR EMERGE	NCE:		,	· •	
0 1	Number of Days Earl	er Than_ Roughride	er		-
0 5	Number of Days Late	rThanNekota			*
T 470 ((2 00) 4 · · ·	by the Plant Variety Protection Off				Page 1

8. ANTHER COL	OR:			······································	
1	1 = Yellow	2 = Purple			
9. PLANT HEIGH	HT (from soil to top of hea	id, excluding awns):			
, i	cm Tailer Than	Nekota			
0 5	cm Shorter Than	Roughrider			*
			• Relative to a	a PVPO-Approved Commercial Variety C	Frown in the Same Tri
10. STEM:					
A. ANTH	OCYANIN		D. INTERNOI	DE (SPECIFY NUMBER)	5
1 1=	Absent 2=Present	÷	1 1= Holl	low 2=Semi-solid	3=Solid
B. WAXY	BLOOM		E. PEDUNCLI	E	
2 1=	Absent 2=Present		2 1=Abse	ent 2=Present	
C. HAIRI	NESS (last internode of ra	achis)	12 cm Len	gth	
1=	Absent 2=Present				
11. HEAD (at Ma	turity):				
A. DENSI	TY		C. CURVATU	RE	
	Lax 2=Middense Dense	e	1 = Ere	ct 2 = Inclined	3 = Recurved
B. SHAPE	3		D. AWNEDNE	ess	
1 1=	Tapering 2= Strap Clavate 4 = Other (S	PECIFY):	1 = Awi		d
12. GLUMES (at I	Maturity):	•			•
A. COLO	R		C. BEAK		
ب ب	White 2 = Tan Other (SPECIFY):	red	3	1 = Obtuse 2 = Acute 3 = Acuminate	
3 –	omer (or boar 1).	· · ·			
B. SHOUL	LDER		D. LENGTH		
ے 3 سا	Wanting 2 = Oblique Rounded 4 = Square Elevated 6 = Apiculat	e	2	1 = Short 2 = Medium (ca. 7mm) (ca. 8mm 3 = Long (ca. 9mm))

12.	GLUME	S (at Maturity) <i>Cont</i>	inued:					· · · · · · · · · · · · · · · · · · ·
•	E. V	/IDTH						
		1 = Narrow (ca. 3 3 = Wide (ca. 4m		edium (ca. 3.5mi	n)			
13.	SEED:							
	A. SI	HAPE			C. BR	USH		•
	3	1 = Ovate	2 = Oval	3 = Elliptical	2	1=Short	2=Medium	3=Long
					1	1 = Not Collared	2 = Collared	•
	B. Cl	HEEK			D. CR	EASE		
• .	2	1=Rounded 2	2=Angu <u>l</u> ar		1	1 = Width 60% or less 2 = Width 80% or less 3 = Width Nearly as W	of Kernel	****
					1	1 = Depth 20% or less 2 = Depth 35% or less 3 = Depth 50% or less	of Kernel of Kernel	
	E. Co	lor			G. PH	ENOL REACTION (se	e instructions):	
	3	1=White 2 4= OTHER (Spec	= Amber ify)	3= Red		1 = Ivory 3 = Light Brown 5 = Black	2 = Fawn 4 = Dark Brown	
	F. TE	XTURE						
		1=Hard	2=Soft		÷			
14.	DISEASE:	(0=Not Tested	i; 1=Suscep	tible; 2=Resis	tant; 3	=Intermediate; 4=To	lerant)	
•	٠.	PL	EASE INDICA	TE THE SPECI	FIC RAC	E OR STRAIN TESTE	D	
·	3	Stem Rust (Puccin	nia graminis 🕻	sp. <i>tritici)</i>	1	Leaf Rust (Puccinia re	condita f. sp. tritici)	. and
	0	Stripe Rust (Pucc	inia striiformis,		0	Loose Smut (Ustilago 1	tritici)	
	0	Tan Spot (Pyreno)	phora tritici-rej	ventis)	0	Flag Smut (Urocystis a	gropyri)	
	0	Halo Spot (Seleno	phoma donacis)	0	Common Bunt (Tilletia	a tritici or T. laevis)	
	0	Septoria nodorum	(Glume Blotch)	0	Dwarf Bunt (Tilletia co	ontroversa)	
	0	Septoria avenae (S	Speckled Leaf I	Disease)	0	Karnal Bunt (Tilletia i	ndica)	
· .	1	Septoria tritici (Sp	eckled Leaf Bl	otch)	0	Powdery Mildew (Erys	siphe graminis f. sp.	tritici)
	2	Scab (Fusarium s	pp.)		0	"Snow Molds"		
						•	•	. (

			<u></u>						
14.	Diseas	se (Continued)	(0=Not Tested;	1=Susceptibl	e; 2=1	Resistant;	3=Intermediate;	4=Tolerant)	
			PLEASE IN	DICATE THE	SPECI	FIC RACE	OR STRAIN TEST	ED	
	0	"Black Point"	(Kernel Smudge)		4	Common Bipolaris	Root Rot <i>(Fusariun</i> spp.)	n, Cochliobolus an	ıd
	0	Barley Yellow	Dwarf Virus (BYD)	v)	0	Rhizocton	ia Root Rot (Rhizo	ctonia solani)	
	0	Soilborne Mo	saic Virus (SBMV)	÷	0	Black Cha	aff (Xanthomonas c	ampestris pv. trans	ilucens)
	0	Wheat Yellow	(Spindle Streak) Mo	saic Virus	0	Bacterial syringae)	Leaf Blight <i>(Pseudo</i>	omonas syringae p	v.
	0	Wheat Streak	Mosaic Virus (WSM	IV)		Other (SI	PECIFY)		
and the		Other (SPEC	IFY)			Other (SI	PECIFY)		·
		Other (SPEC	(FY)			Other (SI	PECIFY)	·	
		Other (SPEC	IFY)			Other (SF	PECIFY)		
15. IN	SECT:	(0=Not Tes	ted; 1=Susceptibl	e; 2=Resista	int; 3	=Intermedi:	ate; 4=Tolerant)		
			PLEASE	SPECIFY BIO	TYPE (where need	ed)		
A CONTRACT	1	Hessian Fly (A	Aayetiola destructor)			Other (SF	PECIFY)		
• • •	0	Stem Sawfly (Cephus spp.)			Other (SP	PECIFY)		
		Cereal Leaf Be	etle <i>(Oulema meland</i>	ppa)		Other (SP	ECIFY)		
	0	Russian Aphid	(Diuraphis noxia			Other (SP	ECIFY)		
- •		Greenbug (Sci	itzaphis graminum)			Other (SP	ECIFY)		
	0	Aphids				Other (SP	ECIFY)		
16. AI	DITION	AL INFÓRMA	TION ON ANY ITE	M ABOVE, OI	R GENE	RAL COM	MENTS		

Exhibit D Harding (SD92107) Additional Description of the Variety

The following additional descriptive information is presented:

- 1) Release notice of Harding.
- 2) Table 1: Yield, test weight, heading, and plant height data of Harding in the South Dakota Crops Performance Testing (CPT) variety trial.
- 3) Table 2: Yield and test weight performance data of Harding in the South Dakota Crops Performance Testing (CPT) variety trial in 19 locations-years.
- 4) Table 3: Grain yield data of Harding in the South Dakota Crops Performance Testing (CPT) variety trial at individual locations.
- 5) Table 4: Test weight data of Harding in the South Dakota Crops Performance Testing (CPT) variety trial at individual locations.
- 6) Table 5: Milling and baking data of Harding in the South Dakota Crops Performance Testing.



NOV 2 9 1999

College of Agriculture and Biological Sciences

Agricultural Experiment Station

Office of the Director

Box 2207, Ag Hall 129 SDSU Brookings, SD 57007-0291 Phone 605-688-4149 FAX 605-688-6065

DATE:

November 19, 1999

TO:

Agricultural Experiment Station Directors

North Central Region and Great Plains

FROM:

Kevin D. Kephart, Director

Agricultural Experiment Station

SUBJECT:

Release of Cultivars

The South Dakota Agricultural Experiment Station announces the release of the following cultivar:

SD92107 Hard Red Winter Wheat -Proposed name 'Harding', PVP recommended

The release date is November 12, 1999.

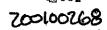
A description of the new release is enclosed. Complete yield and agronomic data is available on request from the Plant Science Department.

Seed is available through the Foundation Seed Stocks Division, Department of Plant Science, South Dakota State University, Brookings, SD 57007 (605-688-5418) FAX (605-688-6633) E-mail: jackfssd@brookings.net

ph

Enclosure

cc: /cultivar Release/Variety Recommendation Committee



SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION SOUTH DAKOTA STATE UNIVERSITY PLANT SCIENCE DEPARTMENT

Release of HARDING Hard Red Winter Wheat

'Harding' hard red winter wheat was developed by the South Dakota Agricultural Experiment Station and released to seed producers in the fall of 1999. Harding is an awned, red-glumed, medium-late maturity, standard-height hard red winter wheat with excellent winter survival ability, very broad disease resistance, and superior yield performance compared to available cultivars in its maturity range. Harding was named after a county in northwest South Dakota where winter survival ability is especially important for successful winter wheat production.

Harding was selected as an F_{5:6} line from the cross 'Brule'/'Bennett'/'Chisholm'/3/'Arapahoe' made in 1986 by Dr. Jeffrey L. Gellner. The cross (coded X96:209) was advanced without deliberate selection to the F₅ generation with a bulk breeding procedure. Breeder seed originated from a composite of approximately 600 F₁₀-derived head-rows selected as part of a glume-color purification program in 1996-1997. Harding was identified as experimental line SD92107 in 1992 and has been tested in the South Dakota Crop Performance Testing (CPT) Variety Trial since 1996 and the Northern Regional Performance Nursery (NRPN) from 1996 to 1998. In four years of statewide testing in the South Dakota CPT (1996 to 1999; 39 environments), Harding (3903 kg ha⁻¹) was lower yielding than '2137' (4193 kg ha⁻¹) and 'Alliance' and Arapahoe (4065 kg ha⁻¹), similar in yield to 'Nekota' (3923 kg ha⁻¹), but higher yielding than cultivars with similar maturity and winter survival ability, including 'Crimson' (3837 kg ha⁻¹), 'Seward' (3675 kg ha⁻¹), 'Elkhorn' (3467 kg ha⁻¹), and 'Roughrider' (3286 kg ha⁻¹). Over this same testing period, at locations where winter injury was an important consideration for yield performance (1996-1997, 13 locations), Harding (4267 kg ha⁻¹) was the highest yielding entry, greater than Arapahoe (4025 kg ha⁻¹), Nekota, and Crimson (3750 kg ha⁻¹), and Alliance (3682 kg ha⁻¹).

Harding is a medium-late maturity wheat (152 days to heading), about 3 days earlier than Seward, 1 day earlier than Roughrider, 2 days later than Arapahoe, and 5 days later than Nekota. Plant height of Harding is tall (38 inches), 2 inches shorter than Roughrider, 2 inches taller than Arapahoe, and 5 inches taller than Nekota. Harding possesses a very broad disease resistance package, being resistant or moderately resistant to stem rust (data provided by USDA-ARS Cereal Rust Laboratory, St. Paul, MN, and the South Dakota State University Small Grains Pathology Program), leaf rust, tan spot, septoria leaf blotch, and wheat streak mosaic virus. In 1998 and 1999, field ratings of reaction to common root rot and head scab suggested some degree of tolerance to both of these pathogens. Harding is heterogeneous for resistance to the Great Plains Biotype of Hessian fly (data provided by USDA-ARS Plant Science and Entomology Research Unit, Manhattan, KS). The coleoptile length of Harding is average (similar to Arapahoe) and the straw strength is fair (slightly less than Arapahoe). The winter survival ability of Harding is very good (similar to Roughrider).

Composite milling and bread-baking data (provided by the USDA-ARS Hard Winter Wheat Quality Laboratory, Manhattan, KS) from the South Dakota Advanced Yield Trial (1995 to 1998) identified Harding as a wheat with overall below average milling characteristics, including average test weight, above average kernel weight, average kernel hardness scores, above average flour ash, and below average flour extraction. Bread-baking tests from these nurseries identified Harding as a wheat with overall above average baking characteristics, including above average flour protein concentration, above average water absorption, average mixing time, above average mixing tolerance, and above average loaf volume. Crumb grain characteristics from experimental and commercial baking tests have been rated as good.

The South Dakota Foundation Seed Division (Plant Science Department, South Dakota State University, Brookings, SD 57007) had foundation seed of Harding available to seed producers for planting in fall 1999. The seed classes will be breeder, foundation, registered, and certified. Harding will be submitted for plant variety protection under P.L. 910577 with the certification option.

Approval

Director, South Dakota Agricultural

Experiment Station

Date

Table 1. South Dakota State University, Winter Wheat Breeding Trials Combined over Locations and Years.

Heading (days) Head	ĺ		04.00	71-77	(25)	33.5	36.0	37 4	H ,	38.I	33.0	38.0		40.5	39.6	a 01		39.1	31.9	27.2		O
Grain Yield (bu/a) Test Weight (lb/bu) Heading (days) (5) (14) (33) (5) (12) (14) (31) (39) 1997 1999 1999 1999 97-99 1997 1998 1999 97-99 1997 1998 1999 97-99 1997 1999 1997 1999 1997 1999 1999 97-99 1999 1999 1999 97-99 1999 169 1090 1997 1149 148 1149 148 1149 148 1149 148 1149 1149 1149 1149 1149 1149 1149 1149 1149 1149 1149 1149 1149		(inches)		2	Ī																	
Grain Yield (bu/a) Test Weight (lb/bu) Heading (days) (5) (14) (33) (5) (12) (14) (31) (39) 1997 1999 1999 1999 97-99 1997 1998 1999 97-99 1997 1998 1999 97-99 1997 1999 1997 1999 1997 1999 1999 97-99 1999 1999 1999 97-99 1999 169 1090 1997 1149 148 1149 148 1149 148 1149 148 1149 1149 1149 1149 1149 1149 1149 1149 1149 1149 1149 1149 1149		nt Height	1008	5 67	(13)	32.8	41															?
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Grain Yield (bu/a) Test Weight (lb/bu) Heading (day) 1997 1998 1997 1998 1997 1998 1997 1998 1997 1998 1997 1998 1999 1997 1998 1999 1997 1998 1999 1997 1998 1999 1997 1998 1999 1997 1998 1999 1997 1998 1999 1997 1998 1999 1997 1998 1999 1997 1998 1999 1997 1998 1997 1998 1997 1998 1997 1998 1997 1998 146.9			66-76		[1]	150.8	153.3	154.3	ת ת	1 (0.101	155.0	156.4) (C.ICI	158.3	152 g	3 4	149.3	152.7	α C	,
Grain Yield (bu/a) 1997 1998 1999 97-99 1997 1998 1999 97-99 1997 (5) (14) (14) (33) (5) (12) (14) (31) (3) 55.5 62.0 62.2 61.2 56.9 61.3 59.3 59.4 163.7 61.3 56.5 60.6 59.0 58.3 60.3 60.0 59.6 165.1 55.6 54.7 55.9 55.4 60.7 62.3 62.0 61.7 165.6 64.7 52.2 55.0 55.3 59.6 58.4 60.0 59.3 166.4 59.1 57.3 57.1 57.5 59.1 61.3 59.9 60.2 163.3 51.6 53.3 55.2 53.9 60.5 61.2 61.4 61.0 166.0 4 7 8 50.3 45.0 47.7 59.2 62.5 60.2 60.8 163.8 4 8 4 54.2 53.7 51.8 58.7 60.7 59.3 59.6 164.4 165.1 55.3 56.9 56.6 56.0 60.1 61.8 58.8 161.9 11.1 13.9 13.7 14.2 14.6 1.8 1.9 2.1 1.9 1.1		lays)	1999	5	(†)	148.8				0 0	147.0	153.6	155.0		14 V + 4	156.4	151.3	, (1	T4/•⊥	150.5	8.0	
Grain Yield (bu/a) Test Weight (lb/bu) 1997 1998 1997 1998 1999 1997 1998 1999 1997 1998 1999 1997 1998 1999 1997 1998 1999 1997 1998 1999 1997 1998 1999 1997 1998 1999 1997 1998 1999 1997 1997 1998 1999 1997 1997 1998 1997 1997 1997 1998 1997 1997 1997 1997 1997 1997 1997 1997 1997 1997 1997 1997 1997 1997 1997 1997 1997 1997 165.1 165.1 165.1 165.1 165.1 165.1 165.1 165.1 165.1 166.4 165.1 166.4 166.0	11.	neading (c	1998	6		140.7	149.7	150.7	151.7	177	7 · · · · · · · · · · · · · · · · · · ·	151.5	152.5	1710	0.74	154.8	149.1	1 4 1 1	140.0	149.0	8.0	
Grain Yield (bu/a) 1997 1998 1999 97-99 1997 1998 1999 97-99 (5) (14) (14) (33) (5) (12) (14) (31) 55.5 62.0 62.2 61.2 56.9 61.3 59.4 (31) 64.7 52.2 55.0 55.3 60.7 62.3 62.0 61.7 64.7 52.2 55.0 55.3 59.6 58.4 60.0 59.6 59.1 57.3 57.1 57.5 59.1 61.3 59.9 60.2 51.6 53.3 55.2 53.9 60.5 61.2 61.2 61.0 8 50.5 44.3 43.5 44.9 59.4 61.1 60.1 60.3 48.4 54.2 53.7 53.2 57.4 59.7 59.5 59.0 55.2 55.7 61.8 58.2 58.7 60.7 59.8 59.6 50.3 58.9 54.3 55.7 56.6 61.1 58.0 58.8 51.8 56.9 56.6 56.0 60.1 61.8 61.0 61.0			1997	6																	1.1	
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(5) (5) 55.5 61.3 61.3 61.3 75.5 75.5 75.5 75.3 75.3 75.3 75.3 75	Grain Yie	1008		(14)	62.0	56.5	7. 7.	· (7.70	57.3	53.3		7	50.3	54.2	; L	7.00	58.9	9,4	000	T3./	•
IANCE PAHOE WSON DING OTA E GHRIDER JT66 ARD IXTAND IO7	_	1007		<u>(</u>)	55.5	61.3	יי		7.70	59.1	51.6	. u		47.8	48.4		7.00	50.3	8,12		L3.9	_
					ANCE	PAHOE	MSON	UNIC		OIA	<u> </u>	quoince	CITATION I	71.66	ARD	TVI A NID	TALES OF	107) EM			

Table 2. South Dakota Crop Performance Testing Summary

2001 2000 1999 1998 Brookings Martin Winner Oelrichs Wall (19 Locations-Years)

No.	Entry	Average	Average
		GY (bu/a)	TW (Ib/bu)
1 A)	LLIANCE	65.8	59.8
2 W	ESLEY	65.3	58.9
3 AI	RAPAHOE	62.4	59.0
4 W	INDSTAR	61.9	58.3
5 VI	STA	61.8	59.3
6 CI	ULVER	61.0	59.0
7 TA	ANDEM	59.4	60.7
8 J <i>A</i>	GGER	58.6	59.3
9 CI	RIMSON	58.6	60.8
10 NI	EKOTA	58.5	59.8
11 TA	MM 107	58.5	58.9
12 H	ARDING	56.0	59.3
13 RA	ANSOM	55.7	57.9
14 RC	OSE	54.6	60.6
15 SC	COUT66	50.8	60.4
Mo	ean	59.3	59.5

Table 3. Grain yield data of Harding in the 2001 South Dakota Crops Performance Testing (CPT) variety trial at individual locations.

ENTRY	1	2	3	4	5	6	7	8	۵	10	AVE	RANK
2137	23.8	 35.9	22.0	46.7	49.6	31.2	64.5	34.5	9 43.6	29.2	38.1	
WINDSTAR	50.2	70.5	30.9	43.2	51.9	30.9	64.4	39.1	55.5	74.9	51.1	34
WESLEY	41.9	70.3	33.0	50.5	55.2	30.3	70.6	38.5	61.5	54.6	50.6	6 8
WAHOO (NE94654)	35.9	69.1	34.5	52.8	58.6	30.1	69.4	42.7	58.6	32.7	48.5	0 17
VISTA	34.7	66.1	31.5	48.4	55.6	37.2	66.3	44.4	54.7	60.8	50.0	11
	5	00.1	51.5	40.4	33.0	37.2	00.5	44.4	J 4 ./	60.6	30.0	- ''
TREGO	33.1	72.5	26.2	49.4	51.2	29.2	67.7	34.6	51.7	44.6	46.0	21
TANDEM	47.1	69.8	33.9	48.6	55.1	37.7	60.9	40.2	60.8	49.3	50.3	10
TAM 107	22.2	36.6	13.7	48.0	50.8	30.8	61.0	30.2	47.7	36.6	37.8	36
STANTON	27.3	56.4	24.4	46.9	48.2	20.7	66.6	30.5	55.1	28.4	40.4	30
SD97W650	32.3	38.0	22.9	46.8	53.3	22.8	69.0	28.4	47.2	32.2	39.3	32
	_				00.0		03.0	20.4	77.42	JL.L	33.3	32
SD97W609	34.6	62.8	27.5	46.2	47.3	31.5	68.5	29.8	51.9	39.2	43.9	23
SD97W604	26.7	64.9	24.4	47.9	41.3	19.1	67.9	28.3	50.3	31.6	40.2	31
SD97457	38.8	65.6	29.6	45.2	51.9	32.2	68.1	34.7	65.3	40.6	47.2	20
SD97250	43.2	56.8	38.5	45.9	57.7	30.1	63.4	40.3	60.4	58.8	49.5	13
SD97049	36.9	57.9	28.9	43.8	54.7	22.3	68.4	36.8	57.4	49.7	45.7	22
				_				33.5	0	10.7	10.1	
SD92107-5	45.6	67.3	34.5	45.4	56.0	37.5	66.7	45.5	63.2	48.3	51.0	7
SD92107-3	39.7	77.4	32.8	45.8	46.6	29.8	63.2	40.3	64.1	64.6	50.4	9
SCOUT66	31.0	41.5	29.6	44.4	51.9	30.5	56.9	40.7	48.6	46.7	42.2	28
ROSE	26.9	61.6	29.3	47.3	46.0	30.3	62.0	29.1	50.1	51.0	43.4	24
RANSOM	53.8	73.6	37.2	48.2	49.4	29.4	61.9	42.0	58.3	79.0	53.3	1
									00.0	. 0.0	00.0	•
QUANTUM 7588	39.3	61.1	18.9	53.0	59.6	37.1	76.2	31.6	46.7	61.8	48.5	16
NUPLAINS	28.9	46.7	30.0	50.0	51.9	28.2	64.5	37.7	42.3	50.2	43.0	26
NEKOTA	43.9	62.1	31.2	50.0	54.0	39.8	63.0	35.9	52.2	58.6	49.1	15
MILLENNIUM	47.5	79.3	33.7	48.5	57.8	36.5	67.7	45.8	54.2	54.4	52.5	3
JERRY (ND9251)	53.0	81.1	37.5	53.8	46.0	30.8	60.2	34.6	61.3	73.4	53.2	2
JAGGER	24.0	29.1	17.7	42.2	57.2	23.8	66.9	33.1	44.6	26.0	36.5	37
HONDO	41.0	45.4	26.8	48.0	55.1	25.3	59.4	30.0	44.5	54.5	43.0	27
HARDING	40.4	53.7	28.8	44.2	53.3	39.0	64.1	41.6	62.3	66.6	49.4	14
GOLDEN SPIKE	9.8	44.2	24.6	54.3	53.6	24.0	67.7	33.2	48.1	19.9	37.9	35
GM10002	29.5	62.8	23.2	49.3	46.4	31.4	67.5	33.5	48.9	38.7	43.1	25
GM10001	35.1	62.0	25.9	45.8	43.9	25.5	67.2	26.7	60.3	28.4	42.1	29
FALCON	48.6	75.3	39.4	49.0	49.3	29.7	62.2	39.8	57.9	69.0	52.0	5
CULVER	42.6	56.4	29.0	49.8	52.4	40.0	66.2	36.2	48.2	53.7	47.4	19
CRIMSON	35.7	66.8	31.3	48.5	52.3	27.8	62.3	40.7	51.9	57.4	47.5	18
CO940611	31.5	30.1	23.5	49.1	52.3	29.2	68.7	27.2	41.4	31.2	38.4	33
ARAPAHOE	46.9	71.0	40.4	46.7	57.1	31.7	65.6	39.7	58.7	65.9	52.4	4
ALLIANCE	41.7	69.5	36.4	46.0	51.6	35.5	68.8	36.3	58.3	54.4	49.8	12
RAE A NI	27 2	60.1	20.5	47.5	E0 -	25-	-		_		-	
MEAN C.V.	37.2	60.1	29.3	47.8	52.1	30.5	65.6	36.1	53.7	48.9	46.1	
C.V. LSD (.05)	21.5	19.1	19.9	9.0	8.6	22.3	4.8	18.5	13.9	24.0		
F2D (103)	11.4	16.3	8.2	6.0	6.3	9.6	4.4	9.5	10.4	16.8		

Crop Performance Testing sites in South Dakota: 1 = Britton, 2 = Brookings, 3 = Highmore, 4 = Martin, 5 = Oelrichs, 6 = Selby, 7 = Wall, 8 = Winner, 9 = Winner, 10 = Watertown.

Table 4. Test weight data of Harding in the 2001 South Dakota Crops Performance Testing (CPT) variety trial at individual locations.

FAITDV		2	2		F	_	-		•	10	A > / E	DANIZ
ENTRY	1	2	3	<u>. 4</u>	5	6	7_	8	9_			RANK
ALLIANCE	56.0	58.2	58.0	59.0	59.6	54.5	60.2	57.8	60.6	55.6	57.9	22
ARAPAHOE	59.3	58.0	58.4	60.3	60.4	55.7	60.6	55.4	58.2	57.9	58.4	16
CO940611	55.0	56.7	58.7	61.6	62.4	57.1	61.1	57.5	58.3	55.1	58.3	18
CRIMSON	60.8	60.9	60.1	62.0	62.8	58.1	63.1	59.8	60.1	58.7	60.6	1
CULVER	57.0	57.0	57.1	59.2	60.4	55.2	59.7	54.0	56.6	56.2	57.2	29
FALCON	56.9	57.1	59.4	59.7	F0 0	E2 0	60.3	FO 1	E4.C	E7 0	F7.0	20
GM10001	56.8	56.9	59.4 58.8	60.3	58.8	53.9	60.2	58.1	54.6	57.8	57.6	26
GM10001	56.8	59.0			59.4	53.9	61.1	52.7	61.6	50.6	57.2	30
GOLDEN SPIKE	30.0	52.8	59.5 49.5	61.0	49.8	56.5	61.8	57.5	58.3	56.1	57.6	25
HARDING	59.8	57.6		60.0	60.1	51.9	58.2	52.1	52.8	45.6	53.7	37
HANDING	33.0	57.0	55.1	60.8	60.6	56.5	61.1	57.6	60.4	59.3	58.9	12
HONDO	59.8	57.5	59.8	61.8	62.7	57.9	62.3	58.9	58.5	57.8	59.7	4
JAGGER	52.8	55.6	54.4	60.3	61.9	54.0	59.7	58.2	55.8	51.4	56.4	33
JERRY (ND9251)	60.3	58.9	58.1	60.1	59.2	56.5	60.0	54.4	58.9	58.3	58.4	15
MILLENNIUM	60.5	60.6	59.9	61.4	61.4	58.0	61.4	57.5	57.3	57.8	59.6	6
NEKOTA	58.5	58.1	59.5	61.1	61.7	57.9	61.0	58.1	57.5	58.9	59.2	10
			00.0	• • • • • • • • • • • • • • • • • • • •	0	0113	0110	00.1	57.15	00.5	JJ.L	
NUPLAINS	58.4	58.2	60.7	62.5	61.9	57.9	62.8	60.2	58.4	57.6	59.9	3
QUANTUM 7588	57.0	56.8	53.9	59.6	59.8	55.7	59.4	52.9	52.8	56.1	56.4	34
RANSOM	59.5	57.5	56.1	58.5	58.5	55.4	59.5	56.2	58.8	58.5	57.8	23
ROSE	60.5	60.0	56.7	61.9	61.0	58.0	62.1	54.9	61.2	57 .9	59.4	7
SCOUT66	59.0	58.7	59.5	61.2	61.9	58.1	61.7	57.7	57.7	57.2	59.3	8
SD92107-3	59.5	58.2	57.0	60.7	60.3	56.3	60.3	57.5	60.8	58.9	59.0	11
SD92107-5	61.0	58.7	57.9	61.1	61.2	58.7	61.3	57.8	58.0	5 6. 7	59.2	9
SD97049	55.0	56.7	56.8	58.7	60.4	54.5	59.3	55.3	55.5	56.4	56.8	32
SD97250	57.3	57.2	58.2	60.5	60.3	56.8	60.6	55.2	59.6	56.0	58.2	20
SD97457	58.3	59.2	58.3	60.8	60.5	56.4	60.9	57.3	60.2	53.2	58.5	13
000714/004												
SD97W604	55.0	58.7	60.2	61.6	60.6	55.2	61.0	57.8	60.3	53.3	58.4	17
SD97W609	56.5	58.3	58.3	60.3	60.3	56.1	60.5	58.3	58.4	55.3	58.2	19
SD97W650	56.5	57.0	56.7	60.5	61.4	55.3	60.5	56.9	56.4	52.3	57.3	28
STANTON	55.3		57.9	60.7	60.4	56.2	60.6	56.8	57.0	53.1	57.7	24
TAM 107	52.6	55.3	57.0	59.3	59.9	53.8	60.3	52.7	56.3	53.1	56.0	36
TANDEM	60.5	59.7	59.3	62.2	62.3	58.2	61.8	E0 4	61.7	F7.0	CO 1	2
TREGO	58.3	60.9	60.3	61.3	61.5	57.5	61.6	58.4 58.9	61.7 59.2	57.0	60.1	2
VISTA	55.8	58.4	59.4	60.3	60.1	57.3 57.1	60.3	58.4	59.2 57.4	56.8	59.6	5
WAHOO (NE94654)	55.0	57.7	55.4	58.6	58.6	54.8	58.9	54.5		57.5 FO.6	58.5	14
WESLEY	55.8	58.7	58.5	60.6					57.5	50.6	56.1	35
·······	55.0	50.7	50.5	00.0	61.6	54.8	59.2	57.8	57.2	55.9	58.0	21
WINDSTAR	59.0	56.7	57.9	60.6	59.6	56.0	59.2	52.4	56.5	57.9	57.6	27
2137	55.3	55.5	58.8	59.9	60.8	55.8	58.2	57.8	55.6	51.3	56.9	31
MEAN						 -						- -
C.V.	57.5 3.0	57.9	57.9	60.5	60.4	56.1	60.6	56.5	58.0	55.8	58.1	
LSD (.05)	2.5	2.5 2.1	2.8	1.0	5.8	2.7	1.3	4.7	7.2	4.2		
L3D (.03)	۷.5	۷.۱	2.4	0.9	4.9	2.1	1.1	4.2	5.8	3.4		

Crop Performance Testing sites in South Dakota: 1 = Britton, 2 = Brookings, 3 = Highmore, 4 = Martin, 5 = Oelrichs, 6 = Selby, 7 = Wall, 8 = Winner, 9 = Winner, 10 = Watertown.

Table 5. Quality parameters of selected varieties grown in South Dakota environments and tested at the Hard Winter Wheat Quality Laboratory, USDA/ARS, Manhattan, KS.

			19	1996-1999	66				₹	>			F				VCH	3	
O	Κ	F	ASH	₹	PR	ABS	2	96	97	98	66	96	97	86	66	96	6	ő	00
Alliance	29.4	68.0	0.38	89.3	10,3	64.1	842	28.9	27.9	29.7	31.0	67.5	69 4	68.8	66.4	0 39	0 37	98.0	0.41
Arapahoe	29.1	6'.	0.45	86.1	11.3	65.0	850	33.5	32.8	34.3	34.1	65.4	72.2	9.69	69.2	0.41	0.35	0.37	0.39
Crimson	28.5	66.4	0.41	83.7	11.5	67.8	927	35.2	30.3	30.1	31.1	65,1	68.5	67.1	67.2	0.44	0 39	0.39	040
Harding		63.9	0.45	77.2	11.6	66.1	925	27.2	31,9	31.3	30.7	66.0	63.7	68.7	68.5	0.46	0.48	0.40	14.0
Jagger	30.6	66.8	0.45	84.2	12.1	68.2	919	27.7	29.5	31,3	27.1	62.8	67.5	70.1	68,0	0.41	0.54	0.47	0.52
Nekota	31,6	68.5	0.39	90.9	11.5	66.1	903	32,4	27.8	28.5	27,4	66.5	68,1	69.5	65,6	0.42	0.45	0.40	0.47
Rose		66.5	0.43	84.4	1.8	68.6	938	30.8	31.0	30.1	32.8	6'99	67.5	71.3	68,6	0.44	0.41	0.37	0.37
Roughrider	28.8	61.9	0.50	82.2	12.2	67.0	972	28.3	31.6	31.7	33.2	64.3	9'69	66.3	72.5	0,48	0.45	0.41	0.41
Scout66	31.8	68.4	0.43	84.5	114	2.99	922	31.4	31.1	32.8	31.5	62.6	68.5		609	0.44	0.47	0.40	0.47
TAM 107	31.7	0'.09	0.41	87.3	10.8	67.8	906	27.9	28,3	28.8	29.0	65.4	70.1		64.9	0.43	0.40	0.40	0.47
Tandem	33.7	69.1	0,38	90.7	11.8	68.6	895	27.9	28.9	29.8	29.6	65.3	70.1		68.0	0.49	0.41	0.43	0.45
Nursery Mean								29.4	28.9	29.4	29.6	65.1	8.69	67.3	8.99	0.46	0.42	0.44	0.44
Nursery S.D.								6	2.2	2.6	2.4	1.7	2.0	1.9	2.0	0.04	0.03	0.07	0.04
Nursery C.V. %								9 9	7.7	8.7	7.9	5.6	2.8	2.8		8.40	7.43	16.33	8
Subset Mean	30,4	67.3	0.43	85.5	11.5	6.99	606	30.1	30.1	30.8	30.7	65.3	68.7		_		0.43	0.40	0 43
Subset LSD (,05)	1,6	1.7	0.03	5.4	0.4	1.4	35										2	}	:
Subset C.V. %	4.5	2.2	5.52	5,3	3.2	<u>.</u> αί	m												
							1				1				-				

		2	WS.			PRO	اہ			¥	ABS			2		
₽	96	97	98	99	96	97	98	99	96	26	98	66	96	97	98	99
Alliance	87.3	88.2	92.1	89.7	10.3	10.7	6.6	10.3	66.3	65.1	62.0	63.0	818	853	810	885
Arapahoe	79.8	95.0	93.1	94.8	11.9	12.7	11.4	11.2	71.0	70.0	67.3	66.1	878	953	883	865
Crimson	77.0	87.6	90,4	94.4	10,4	11.4	10.4	11.0	70.1	67.2	67.3	66.5	865	935	920	905
Harding	92.1	64.5	89.2	95.0	12,9	10.7	11.3	11.6	66.2	70.1	66.0	65.5	1050	850	920	950
Jagger	88.0	73.3	84.6	78.7	11.8	11.8	12.6	11.6	67.3	9.69	66.3	65.8	975	888	993	955
Nekota	95.1	86.0	86.4	77.3	11.2	11.8	12.2	11.3	64.8	68,8	71.2	6.99	915	883	943	950
Rose	89.4	86.0	92.2	90.1	11.9	12.1	1.8 8.	10.8	0.99	69.2	65.2	65.1	920	905	913	880
Roughrider	75.1	86.5	85.7	89.4	12.5	12.0	11.9	12.1	71.9	68.7	66.3	65.2	890	930	935	968
Scout66	71.7	80.6	81.1	75.3	11.2	12.3	11.1	1.9	8'69	67.0	64.7	62.8	918	096	895	925
TAM 107	77.6	86.2	83.8	87.0	11.0	12.1	11.3	11.6	71.2	67.8	65,0	67.3	873	940	930	965
Tandem	9'92	87.7	85.1	94.8	11.3	11.4	10.7	11.8	6.5.9	64.4	64.7	64.8	818	868	795	920
Nursery Mean	76.1	85.4	85.7	89.5	11.0	11.8	11.1	==	67.9	9.99	65.4	65.0	838	922	892	891
Nursery S.D.	5.1	4.4	4.9	5.8	9'0	9.0	9'0	0.7	2.3	2.0	د .	1.5	39	4	46	63
Nursery C.V. %	6.7	5.2	5.7	6.5	2.7	4.8	5.1	9'9	3.4	3.0	2:1	2.2	ιŋ	4	ĸ	7
Subset Mean	82.7	83.8	9.78	87.9	11.5	11.7	11.3	11.4	68.2	68.0	0.99	65.4	905	906	903	924
						ĺ		1	ĺ		İ					

KW = Single kernel weight (mg); FY = Flour yield (percent of total product); ASH = Flour ash (percent at 14% moisture basis); MS = Milling Score (100 point scale derived from testweight, flour yield, ash and protein conversion); PRO = Flour protein (percent at 14 % moisture basis); ABS = Flour (bake) absorption (14 % moisture basis); LV = Loaf volume (cc).

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South Dakota Agricultural Experiment Statio	n SD92107	Harding	
4. ADDRESS (Street and No., or R.F.D. No., City, State, and ZIP, and Country)	5. TELEPHONE (include area code)	6. FAX (include area code)	
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Brookings, SD 57007	7. PVPO NUMBER		
	200100	200100268	
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Is the applicant (individual or company) a U.S. national or U.S. based If no, give name of country	d company?	X YES NO	
10. Is the applicant the original owner? X YES	NO If no, please answer one of the	following:	
a. If original rights to variety were owned by individual(s), is (are) the	e oríginal owner(s) a U.S. national(s)?		
YES	NO If no, give name of country		
b. If original rights to variety were owned by a company(ies), is(are)	the original owner(s) a U.S. based compan	ý?	
YES	NO If no, give name of country		
1. Additional explanation on ownership (if needed, use reverse for extra	a space);		
	·		
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- which affords similar protection to nationals of the U.S. for the same genus and species. mai, national of a UPOV member country, or national of a country
- 2. If the rights to the variety are owned by the company which employed the original breeder(s), the company must be U.S. based, owned by nationals of a UPOV member country, or owned by nationals of a country which affords similar protection to nationals of the U.S. for the same genus and species.
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